are somewhat reversed, the evergreens being mostly in places unattractive to farmers, and the apparent percentages of them probably too high. The percentage of improved land in West Virginia and Arkansas is rather low, perhaps chiefly because these states are off the main routes of travel and have not received as many settlers as their soil would warrant. It is low in Mississippi and Louisiana on account of large areas of alluvial land, which although very rich (and originally wooded almost exclusively with deciduous trees) were very little cultivated in 1880 on account of being subject to overflow. In the northern states improved land includes a large proportion of pasture, on which no fertilizer is used, and if the amount of cultivated land could be substituted for improved land the fertilizer figures for these states would average considerably more per acre.

Finally, it can not be doubted that different chemical elements in the soil affect evergreen percentages and other features of vegetation unequally, and it is well known that the composition of rich soils varies greatly in different states. The soils of Florida are generally well supplied with calcium and phosphorus, but deficient in potassium, while in Illinois phosphorus is said to be the element most in danger of exhaustion. The average composition of fertilizers used varies from state to state, corresponding more or less with the soils (a larger proportion of potassium is used in Florida than in any other state), but no statistics of fertilizer ingredients are given in census reports; so that matter will not be taken up at the present time.

ROLAND M. HARPER

SPECIAL ARTICLES

STANDARD DAIRY SCORE CARDS

MR. JAMES D. DREW[1] presents data which should be of very general interest. The purpose of this note is to direct attention to these studies in the hope that they may receive the wide attention which they deserve. The most important result of such consideration would be the carrying out of even more comprehensive and exact studies of the same kind.

The problems taken up are essentially two:

a. What is the correlation between the grades assigned a series of dairies by the same inspectors when different score cards are used?

b. What is the correlation between the score assigned a dairy by an inspector and the quality of the milk which it places upon the market?

The first of these problems is of technical importance in determining the degree of reliability of the application of score cards to the grading of dairies. The second is fundamental to the determination of the utility of the score card in the grading of milk, and thus one of first rate practical significance to the consumer of dairy products.

For purposes of review it has seemed best to express the detailed observations in the succinct terms of statistical constants. The personal opinion of the reviewer that such statistical constants are better as a means of expressing the results than the mere comparison of individual points of detail, and his conviction that the analysis of the data in certain of its more refined essentials can be carried out only by such formulæ, must not be taken as a criticism of the data or their discussion in the paper under review.

With regard to the agreement between the three methods of grading, the authors confine their discussion to the relative positions of the individual dairies on the three score cards. The correlation coefficients[2] are illuminating. They are:

[1] Drew, J. D., "Milk Quality as Determined by Present Dairy Score Cards," *Bull. N. Y. Agr. Exp. Sta.*, 398, Geneva, March, 1915. The work was originally planned by Dr. H. A. Harding, and is now being carried out in cooperation with the Illinois Agricultural Experiment Station.

[2] Data for 34 barns are given. For 23 of these bacterial counts for morning milk as well as evening milk are available. As a precaution against arithmetical slips I have marked out the correlations between the results by the three cards for both the total series and the sub-series for which morning milk was available. The latter should be essentially a random sample of the former.

Card Used	$N = 34$	$N = 23$
New York City and Official score	.770 ± .047	.713 ± .069
New York City and Cornell score	.719 ± .056	.803 ± .050
Official score and Cornell score	.831 ± .036	.769 ± .057

These results for total score by the three different cards are high, but they fall far short of the $r = 1$ which indicates perfect correlation, and which should be obtained if (*a*) the score cards were perfect descriptions of the barns as places for milk production, and if (*b*) the inspectors had perfect judgment in the filling out of the cards. It is interesting to note that the grades assigned by the three methods agree equally closely (within the limits of the probable errors of sampling) whatever cards are used: New York City and Official, New York City and Cornell, and Official and Cornell gradings have sensibly the same correlation.

In the case of the New York City and the Official score, methods are graded separately. The correlations are

For 34 barns, $r = .480 \pm .089$
For 23 barns, $r = .412 \pm .117$

Thus the correlation for methods are but slightly over half the size of those for total score. This suggests that the 40 points awarded for equipment in both the New York City and the United States Department of Agriculture ("Official") cards is the great factor in bringing about a close agreement in the results (total score) obtained by the two methods. Correlating points assigned for equipment only (total score *minus* score for methods) I find

For 34 barns, $r = .733 \pm .054$
For 23 barns, $r = .685 \pm .075$

The lower correlation of the values assigned for methods as compared with those for equipment is perhaps the most serious criticism to be made of the score cards.

While the agreement between the scores assigned by different cards falls far short of perfect correlation, it is interesting to note that *the agreement is actually closer than that for bacterial count in evening and morning milk from the same dairies.* Here the correlation is only

$$r = .456 \pm .111.$$

The relationships between the scores assigned by the various cards and the bacterial counts are naturally the results of the greatest interest. All the possible correlations have been worked out and are presented in the accompanying table.

CORRELATION OF BACTERIAL COUNT WITH SCORE-CARD ENTRIES

Card Used	Evening Milk, 34 Barns	Morning Milk, 23 Barns
New York City		
Total score	— .077 ± .115	— .046 ± .140
Methods only	+ .024 ± .116	— .061 ± .140
Equipment only	— .170 ± .113	— .022 ± .141
Official		
Total score	— .003 ± .116	— .196 ± .135
Methods only	— .140 ± .113	— .310 ± .127
Equipment only	+ .065 ± .116	— .039 ± .141
Cornell	— .013 ± .116	— .102 ± .139

Twelve out of 14 of these correlations are negative in sign. All six of those for total score are negative. In other words, as the ratings assigned by the inspectors became higher the bacteria became fewer. This is of course as one would like it to be. Practically, however, the author's statement, that there is apparently no correlation between the bacterial count and score as expressed by any one of the cards, fully expresses the facts. The constants are almost without exception very small indeed. There is not a single one which can be safely considered as significant in comparison with its probable error!

Such are the results:

a. The correlation between the total scores assigned the same barns by the same inspector using the three most important cards is only about three quarters of its theoretical maximum value. The correlation between the scores for methods only is less than half its theoretical value.

b. There is practically no correlation at all between the scores assigned the barns by dairy inspectors and the bacterial content of the milk which they place upon the market.

c. When correlations so low as those deduced from the present figures are found between the bacterial counts of morning and evening

samples of milk from the same barns, it is clear that much remains to be done in the perfection of the technique of sampling and bacteriological analyses of milk.

These data show how flimsy is the basis for the common belief that there is a relation between the score of a dairy and the quality of the milk produced by it, and how premature the official sanction for the grading of milk by means of dairy scores.

J. ARTHUR HARRIS

"SOIL ACIDITY AND METHODS FOR ITS DETECTION"[1]

IN a previous issue of SCIENCE, J. E. Harris[2] published an article entitled similarly as above. In this article Harris states that two theories have been advanced to explain soil acidity, viz., the humic-acid theory and the colloid absorption theory. This same investigator also makes reference to an article published by the present writer on a new method for the determination of soil acidity,[3] and after quoting the writer in regard to the use of calcium chloride in this method, says:

> This statement brings out very clearly the absurdity of the position of those who accept the humic acid theory. These humic acids are supposed to be strong enough and soluble enough to liberate hydrochloric acid from calcium chloride, but not strong enough or soluble enough to liberate hydrogen sulphide from zinc sulphide. It is also suggested that this method be made the basis for a quantitative determination of the lime requirements of the soil. The writer does not believe this is possible because he has shown[4] that acid soils do not absorb equivalent amounts of different ions.

Although Harris apparently assumes that the writer believes soil acidity in upland soils is due largely to the so-called humic acids, yet the writer has never published such views or believed that such was the case. The writer also wishes to state that he is even more adverse to accepting the colloid absorption theory as an explanation of soil acidity, than he is to accepting the so-called humic acid theory. The acidity of peat and muck soils is undoubtedly due in part to organic acids. There are upland soils, however, which are practically free of organic matter and still they react strongly acid. Similar soils containing considerable organic matter appear to retain all their acid properties even after the organic matter is destroyed with hydrogen peroxide. What is this inorganic acidity due to? Harris and many other investigators have assumed that it is due to absorption of bases by soil colloids. They have arrived at this conclusion because by their methods of experimentation, acid soils do not take up chemically equivalent amounts of the different bases. Colloids exhibit similar properties as to the absorption of bases, and hence they conclude that soil acidity is due to colloids. Let us carefully examine the facts and draw our conclusions accordingly:

Upland soils consist of from 75 per cent. to over 95 per cent. of silicates and silica. Silicates are salts of various silicic and aluminosilicic acids. The water solution in the soil slowly reacts with these silicates, forming with the bases of the silicate a soluble hydroxide or salt, which is taken up by plants or removed in the drainage water. The other product, an acid silicate, being comparatively insoluble, accumulates in the soil and gives rise to an acid condition. The writer and assistants have treated powdered basalt, granite, feldspar and other minerals with carbonated water, and after filtering have obtained residues which are acid to litmus and other tests. This is essentially comparable to the weathering process going on in soils. Acid soils treated in this way are made more acid.

If soil acidity is due to true acids and acid salts such as acid silicates, why have investigators not been able to show that acid soils take up equivalent amounts of the different bases from salt solutions? This is due to the fact that the acid silicates and their neutralized products are only very slightly soluble, and the solubility of the neutralized silicates varies according to the base that effects the neutralization. The law on which the ad-

[1] Published with the permission of the director of the Wis. Expt. Station.

[2] SCIENCE, 40 (1914), 49.

[3] SCIENCE, 40 (1914), 246.

[4] *Jour. Phy. Chem.*, 18 (1914), 355.